Background

NVIDIA GRID vGPU enables multiple Virtual Machines (VM) to have simultaneous, direct access to a single physical GPU, using the same NVIDIA graphics drivers that are deployed on non-virtualized Operating Systems. Under the control of NVIDIA's GRID Virtual GPU Manger, which runs in XenServer's Control Domain (dom0), GRID physical GPUs are capable of supporting multiple virtual GPU devices (vGPUs) that can be assigned directly to VMs.

Guest VMs use GRID virtual GPUs in the same manner as a physical GPU that has been passed through by the hypervisor; an NVIDIA driver loaded in the guest VM provides direct access to the GPU for performance critical fast paths, and a paravirtualized interface to the GRID Virtual GPU Manager.

XenServer 6.2.0 Service Pack 1 includes the 3D Graphics Pack (vGPU) for XenServer and an updated version of the XenCenter management console.

Available vGPU Types

NVIDIA Grid K1 and K2 cards contain multiple Graphics Processing Units (GPU). GRID K1 cards contain four GK107GL GPUs, and GRID K2 cards contain two GK104GL GPUs. Each physical GPU (pGPU) can host several different types of virtual GPU (vGPU). vGPU types have a fixed amount of framebuffer, number of supported display heads and maximum resolutions, and are targeted at different classes of workload.

The vGPU types supported by GRID K1 and K2 are defined in the Table 1.

<table>
<thead>
<tr>
<th>Card</th>
<th>No. of Physical GPUs</th>
<th>Virtual GPU Types</th>
<th>Intended Use Case</th>
<th>Max Resolution</th>
<th>No. of vGPUs per GPU</th>
<th>No. of vGPUs per Card</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID K1</td>
<td>4</td>
<td>GRID K140Q</td>
<td>Workstation</td>
<td>2560x1600</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRID K100</td>
<td></td>
<td>1920x1200</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>GRID K2</td>
<td>2</td>
<td>GRID K260Q</td>
<td>Workstation</td>
<td>2560x1600</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRID K240Q</td>
<td>Workstation</td>
<td>2560x1600</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRID K200</td>
<td>VDI</td>
<td>1920x1200</td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 1 Virtual GPU Types

Note: At any given time, vGPUs hosted on a physical GPU must all be of the same type. However, there is no corresponding restriction between physical GPUs on the same card. This restriction is automatic and may cause unexpected capacity planning issues.

For example, a GRID K2 card, has two physical GPUs, and can support three types of vGPU; GRID K200, GRID 240Q, and GRID 260Q.
Pre-requisites:

- NVIDIA GRID K1 or K2 cards:
  Customers who have installed Hotfix XS62ESP1004 can use additional NVIDIA GRID cards and vGPU types.
  Hotfix XS62ESP1004 is available from [https://support.citrix.com/article/CTX140417](https://support.citrix.com/article/CTX140417)
  - For the most recent vGPU types refer to [http://www.nvidia.com/object/virtual-gpus.html](http://www.nvidia.com/object/virtual-gpus.html).
  - For the most recently supported NVIDIA cards refer to

- A server capable of hosting XenServer and NVIDIA GRID cards.
  (Refer to the vGPU Release Notes at [www.citrix.com/go/vgpu](http://www.citrix.com/go/vgpu) for details of recommended hardware)
- Citrix XenServer 6.2.0 Service Pack 1 or later
- The NVIDIA GRID vGPU software package for Citrix XenServer, consisting of the GRID Virtual GPU Manager for XenServer, and NVIDIA drivers for Windows 7 32-bit/64-bit

To run Citrix XenDesktop with VMs running NVIDIA vGPU, you will also need:

- Citrix XenDesktop 7.1 or later full installation

**Note:** No other versions of Citrix XenServer or XenDesktop are currently supported for use with NVIDIA virtual GPUs.

vGPU Guest Support

The following guests are supported for use with vGPU:

- Windows 7 (32-bit/64-bit)
- Windows Server 2008 R2 SP1

Customers who have installed Hotfix XS62ESP1004 can also use the following guests:

- Windows 8 (32-bit/64-bit)
- Windows 8.1 (32-bit/64-bit)
- Windows Server 2012
- Windows Server 2012 SP1
Installation Overview:

1. Install XenServer and Apply Service Pack 1
2. Installing the NVIDIA GRID vGPU Manager for XenServer
3. Create a vGPU Enabled VM
4. Boot the VM and install the NVIDIA drivers
Install XenServer and Apply Service Pack 1


Refer to the XenServer Quick Start Guide for comprehensive details on installation

http://support.citrix.com/article/CTX137827

2. Install XenServer 6.2.0 Service Pack 1 available from http://support.citrix.com/article/CTX139788

3. Reboot your host.
Installing the NVIDIA GRID vGPU Manager for XenServer

Customers will need the following two components available from NVIDIA - [http://www.nvidia.com/vGPU](http://www.nvidia.com/vGPU):

1. GRID vGPU Manager version 331.30  
   (NVIDIA-vgx-xenserver-6.2-331.30.i386.rpm)

2. Windows Display Driver version 332.07  
   (332.07_grid_win7_64bit_english.exe)

**Note:** The driver versions shown above will change as NVIDIA releases future drivers. Citrix supports customers using future releases of these drivers.

The GRID vGPU Manager runs in XenServer's Control Domain (dom0). It is provided as an RPM file, which must be copied to XenServer's dom0 and then installed. To do this:

1. Use the `rpm` command to install the package:

   ```bash
   [root@xenserver ~]# rpm -iv NVIDIA-vgx-xenserver-6.2-331.30.i386.rpm
   Preparing packages for installation...
   NVIDIA-vgx-xenserver-6.2-331.30
   [root@xenserver ~]
   ```

2. Reboot the XenServer host:

   ```bash
   [root@xenserver ~]# shutdown -r now
   [root@xenserver]
   ```

3. After the XenServer host has rebooted, verify that the GRID package has installed and loaded correctly by checking for the NVIDIA kernel driver in the list of kernel loaded modules:

   ```bash
   [root@xenserver ~]# lsmod |grep nvidia
   nvidia            8152994 0
   i2c_core            20294 2 nvidia,i2c_i801
   [root@xenserver ~]#
   ```

   **Note:** If at this stage, the NVIDIA module (nvidia) is not loaded correctly, refer to [CTX139834](https://support.citrix.com/article/CTX139834) for troubleshooting.

4. Verify that the NVIDIA kernel driver can successfully communicate with the GRID physical GPUs in your host by running the `nvidia-smi` command, which produces a listing of the GPUs in your platform similar to:
3D Graphics Pack: Configuring XenServer to use NVIDIA GRID v2.0
v1.2 April 2014

[root@xenserver ~]# nvidia-smi
Wed Sep 25 13:05:31 2013
+------------------------------------------------------------------------+
| NVIDIA-SMI 4.312.36 Driver Version: 312.36 |-------------------------------+------------------+
| GPU  Name | Bus-Id  | Disp. | Volatile Uncorr. ECC | Compute M. |
| Fan  Temp | Perf    | Pwr:Usage/Cap | Memory-Usage | GPU-Util |-------------------+
|=============================================================================|
| 0 | GRID K1 | 0000:04:00.0 | Off | N/A | N/A | 27C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 27C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| 1 | GRID K1 | 0000:05:00.0 | Off | N/A | N/A | 25C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 25C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| 2 | GRID K1 | 0000:06:00.0 | Off | N/A | N/A | 21C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 21C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| 3 | GRID K1 | 0000:07:00.0 | Off | N/A | N/A | 23C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 23C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| 4 | GRID K1 | 0000:08:00.0 | Off | N/A | N/A | 24C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 24C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| 5 | GRID K1 | 0000:09:00.0 | Off | N/A | N/A | 24C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 24C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| 6 | GRID K1 | 0000:08:00.0 | Off | N/A | N/A | 25C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 25C | P0 | 13W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| 7 | GRID K1 | 0000:09:00.0 | Off | N/A | N/A | 25C | P0 | 12W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| N/A | 25C | P0 | 12W / 31W | 0% | 9MB / 4095MB | 0% | Default |-------------------+
| Compute processes: GPU Memory |GPU PID | Process name | Usage |-------------------+
|=============================================================================|
| No running compute processes found |-------------------+
[root@xenserver ~]#
Create a vGPU Enabled VM

1. Using XenCenter, create a VM. To do this, on the toolbar, select New VM and step through the New VM wizard.
2. Choose the Installation Media, Home Server, CPU & Memory.
3. GPU-enabled servers will now show a GPU configuration page:

![GPU configuration page](image)

4. From the GPU Type drop-down list, select a vGPU type. (Unavailable vGPU types will be greyed-out)
5. Click Next to configure Storage and Networking.
6. When you are happy with your configuration, click Create Now.
Install the NVIDIA drivers

**Notes**
When viewing the VM console in XenCenter, the VM should initially boot to a standard Windows 7 desktop in VGA mode at 800 x 600 resolution.
Customers can use the standard Windows screen resolution controls to increase the resolution to other standard resolutions. (Control Panel → Display → Screen Resolution)

To fully enable vGPU operation (as for a physical NVIDIA GPU) the NVIDIA driver must be installed into the VM.

1. Start the VM. In the Resources pane, right-click on the VM, and click Start. During this boot process XenServer dynamically allocates a vGPU to the VM.
2. Follow the Windows operating system installation screens;
3. Once the OS installation completes, reboot the VM.
4. Copy the 32- or 64-bit NVIDIA Windows driver package to the VM, open the zip file, and run setup.exe.
5. Accept the License Agreement.
6. Select Express Installation:

![NVIDIA Graphics Driver Installation](image)

7. Once the driver installation has completed, you may be prompted to reboot the VM. Select Restart Now to reboot the VM immediately. Alternatively, exit the installer package, and reboot the VM when ready.
8. When the VM starts it will boot to a Windows desktop.
   To verify that the NVIDIA driver is running; right-click on the desktop and select NVIDIA Control Panel.
9. In the NVIDIA Control Panel, select **System Information**.
   This will show the vGPU Type in use by the VM, its capabilities, and the NVIDIA driver version in use:

   ![NVIDIA Control Panel System Information](image)

10. Install the **XenServer Tools**.
    Without the optimized networking and storage drivers provided by the XenServer Tools, remote
    graphics applications running on GRID vGPU will not deliver maximum performance.
    a) Select the VM in the **Resources** pane, right-click, and then click **Install XenServer Tools** on
       the shortcut menu. Alternatively, on the **VM** menu, click **Install XenServer Tools**.
    b) Click **Install XenServer Tools** on the message dialog to go to the VM's console and begin the
       installation.
    c) If **Autoplay** is enabled for the VM's CD drive, installation will start automatically. If Autoplay
       is not enabled, double-click on the CD drive to begin installing the XenServer Tools.
    d) Follow the on-screen instructions, and reboot the VM when prompted.

11. Mount the **XenDesktop** installation media.
    If autorun is not enabled, navigate to and run **AutoSelect.exe** on the installation media.

12. In the XenDesktop installation wizard, select **Virtual Delivery Agent for Windows Desktop OS**:
13. On the **Configuration** screen, select **Create A Master Image**, then click **Next**.
14. On the **HDX 3D Pro** screen, click **Yes, install the VDA for HDX 3D Pro**, and click **Next**.

15. Work through the remainder of the Installation wizard.

   For detailed installation information for the XenDesktop VDA, refer to [http://support.citrix.com/proddocs/topic/xendesktop-7/hd-3d-install.html](http://support.citrix.com/proddocs/topic/xendesktop-7/hd-3d-install.html)

This completes the process for setting up a single VM to use GRID vGPU. The VM is now ready to run the full range of DirectX and OpenGL graphics applications.
Further Information

Customers are advised to review the GRID VGPU FOR CITRIX XENSERVER User Guide (Ref: DU-06920-001) available from NVIDIA - http://www.nvidia.com/vGPU

Customers will need to register with NVIDIA to gain access to these components for additional performance optimization steps.
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